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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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BIRCH STEWART KOLASCH & BIRCH PO BOX 747 FALLS CHURCH, VA 22040-0747				
			EXAMINER SULLIVAN, CALEEN O	
			ART UNIT 1756	PAPER NUMBER

DATE MAILED: 10/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/731,133	<b>Applicant(s)</b> KUO ET AL.	
	<b>Examiner</b> Caleen O. Sullivan	<b>Art Unit</b> 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.138(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application:  
4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                               | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                      | 5) <input type="checkbox"/> Notice of Informal Patent Application                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____  |

## DETAILED ACTION

### *Oath/Declaration*

1. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because: The specification to which the oath or declaration is directed has not been adequately identified. See MPEP § 602.

The oath or declaration only includes the names, addresses and signatures of the inventors with the remainder being left incomplete.

### *Claim Objections*

2. Claims 7 and 16 are objected to because of the following informalities: The term “sad” is incorrectly spelled and should be “said”. Appropriate correction is required.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

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5. Claims 1, 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) in view of Figura ('109).

Wiltshire ('401) discloses the deposition of a photoresist layer over a horizontal surface of an initial film layer of a substrate in which an opening is created by etching of the photoresist layer. The first opening includes a horizontal surface and a vertical surface having width and height dimensions. (See page 3, paragraph 0027). Examiner considers this the equivalent of providing a substrate with an opening exposing a sidewall and opening base surface as stated in claim 1.

Wiltshire ('401) also discloses a second film layer being deposited over the horizontal surface of the initial film layer of the substrate as well as the horizontal and vertical surfaces of the first opening, which is etched from the horizontal surface of the first opening such that the first opening has the same height dimension but has a smaller width dimension. (See page 3, paragraphs 0027 and 0028). Examiner considers this the equivalent of forming a mask layer exposing a sidewall and portion of the opening base surface as stated in claim 1.

Wiltshire ('401) also discloses that a third film layer placed on the horizontal surface of the initial film layer and the horizontal and vertical surfaces of the first opening, this film layer including a dielectric. (See page 3, paragraph 0028). Examiner considers this to be the equivalent of forming a dielectric layer on the exposed sidewall and opening base surface as stated in claim 1.

Wiltshire ('401) goes on to disclose that once etching of the second film layer is complete this second film layer, which is a photoresist, is removed. (See page 3, paragraph 0028). Examiner considers this to be the equivalent of stripping the mask layer as stated in claim 9.

Wiltshire ('401) further discloses that a conductive material is deposited over horizontal surface of substrate and fills the opening. (See page 3, paragraph 0029). Examiner considers this to

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be the equivalent of forming a conductive layer over the substrate after the mask layer is stripped as stated in claim 10.

However, Wiltshire ('401) fails to disclose the formation of a mask layer that is tilted in an opening of a substrate that includes an exposed sidewall and base surface.

Figura ('109) does disclose a sloped masking layer, which is a layer of photoresist. This masking layer tapers from top to bottom within an opening on a substrate. (See col. 2, lines 4-7 and lines 10-17). Examiner considers this to be the equivalent of a tilted mask layer as stated in claim 1.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant, to modify the teachings disclosed in Wiltshire ('401) with the masking layer which tapers from top to bottom as disclosed by Figura ('109) in order to achieve a substrate with an containing a tilted mask layer with a sidewall and opening base surface being exposed, because one achieves an opening that is smaller; therefore, going beyond the current capabilities of conventional photolithography processes to achieve a smaller feature size to increase the functional area of the substrate.

6. Claims 2-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) in view of Figura ('109) as applied to claims 1 and 9-10 above, and further in view of Lammert ('446) and Hu ('802).

Wiltshire ('401) and Figura ('109) are relied upon as discussed in the rejection of Claims 1 and 9-10 under 35 USC 103(a) set forth above in paragraph 5.

Wiltshire ('401) and Figura ('109) fail to disclose heating a photoresist in order to reflow the photoresist into a desired profile.

Lammert ('446) discloses heating a photoresist within a temperature range and for a period of time to achieve a desired photoresist profile. Lammert ('446) also discloses that higher

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temperatures and longer bake times will produce more flow of the photoresist. In one embodiment of the inventive method described in Lammert ('446), the photoresist was heated between the temperature range of 150 C- 200 C and then flowed into the desired shape. (See col. 4, lines 4-16). Examiner considers this to be the equivalent of heating the photoresist during reflow, as stated in claim 3, within a temperature range of 100-150 C and a time range of 100-150 seconds as stated in claim 4.

However, Lammert ('446) fails to disclose a step of hardening the reflowed photoresist by post UV exposure to maintain the desired profile once it is obtained.

Hu ('802) also discloses the use of high temperature flow in order to reduce the size of a resist image of a feature with the added step of stabilizing the reflowed image by deep UV exposure. This freezes the resist profile at the desired reduced size. (See col.2, lines 23-28 and lines 34-41). Examiner considers this to be the equivalent of hardening the photoresist layer by UV after reflow as stated in claim 5.

However, Lammert ('446) and Hu ('802) fail to disclose the limitation where the substrate is tilted in order to reflow the photoresist to form a tilted mask layer. It is inherent that the substrate would need to be tilted or rotated in order to reflow the photoresist material into the desired sloped or tilted formation as stated in claim 2.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant, to modify the teachings of Wiltshire ('401) and Figura ('109) with the step of heating a photoresist material at a temperature and for a period of time particular to the photoresist material in order to reflow the material into a desired shape and the step of deep UV exposure, as disclosed in Lammert ('446) and Hu ('802), because one would be able to achieve a particular profile of the photoresist material, and maintain the desired profile of the photoresist. Moreover, the step of tilting

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the substrate to reflow the photoresist material into the desired shape can be reasonably inferred as a necessity to achieve a tilted or sloped profile.

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) and Figura ('109) as applied to claims 1 and 9-10 above, and further in view of Koizumi ('708).

Wiltshire ('401) and Figura ('109) are relied upon as discussed in the rejection of Claim 1 and 9-10 under 35 USC 103(a) set forth above in paragraph 5.

Wiltshire ('401) and Figura ('109) fail to disclose an ozone ashing method for the removal of photoresist material.

Koizumi ('708) discloses that a photoresist is an organic substance and can be removed by ozone ashing. In this method a photoresist film is exposed to a hot gas, which contains ozone in order to remove the resist film by thermal decomposition. (See col. 1, lines 14-19). Examiner considers this to be the equivalent of the ozone ashing step, which occurs before a dielectric layer is formed as stated in claim 6.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Wiltshire ('401) and Figura ('109) with the ozone ashing method disclosed in Koizumi ('708) in order to remove the photoresist because very little damage occurs to the substrate during exposure to the ashing atmosphere.

8. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) and Figura ('109) as applied to claims 1 and 9-10 above, and further in view of Lin ('786).

Wiltshire ('401) and Figura ('109) are relied upon as discussed in the rejection of Claims 1 and 9-10 under 35 USC 103(a) set forth above in paragraph 5.

Wiltshire ('401) and Figura ('109) fail to disclose the formation of an oxide layer in an opening in a substrate by liquid phase deposition, where the oxide layer formed is a dielectric.

Lin ('786) discloses a method where an oxide layer is formed in a trench within a substrate by liquid phase deposition, and the dielectric material is oxide. Examiner considers this to be the equivalent of growing an oxide layer on an exposed sidewall and base surface of an opening within a substrate before a dielectric layer is formed, where the dielectric layer is the oxide layer formed by liquid phase deposition as stated in claims 7 and 8.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Wiltshire ('401) and Figura ('109) with teachings of Lin ('786) in order to form a dielectric layer on the sidewall and base surface of a substrate by growing an oxide layer which is a dielectric on the sidewall and base surface of the substrate by liquid phase deposition, because the oxide layer formed by liquid phase deposition is selective for photoresist; therefore, it will not grow on the masking layer but instead only the sidewall of the trench in the substrate.

9. Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) in view of Figura ('109) and Lammert ('446) and Hu ('802).

Wiltshire ('401) Figura ('109) Lammert ('446) and Hu ('802) are relied upon as discussed in the rejections of Claims 1-5 and 9-10 under 35 USC 103(a) set forth above in paragraphs 5 and 6.

Wiltshire ('401) also discloses the method described is applicable to semiconductor wafer as the substrate. (See page 3, paragraph 0027). It is also well known in the art that storage nodes are common components of a semiconductor, which typically has a pad dielectric layer thereon as stated in claim 11. Therefore, Wiltshire ('401) discloses coating a photoresist layer on the pad dielectric of the semiconductor substrate as stated in claim 11, when the initial film is deposited on the horizontal surface of the semiconductor wafer. (See page 3, paragraph 0027).



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The disclosures in Figura ('109), Lammert ('446) and Hu ('802) are also related to constructing a semiconductor device, as are the limitations stated in claims 11-14. (See Figura: col. 4 line 55; Lammert: col. 3, line 19; Hu: col. 3, lines 5-9)

Lammert and Hu fail to disclose the limitation of claim 11 where the semiconductor substrate is tilted in order to reflow the photoresist to form a tilted mask layer. As stated above, in the rejection of claims 2-5 in paragraph 6, it is inherent that the semiconductor substrate would need to be tilted in order to reflow the photoresist material into the desired sloped or tilted formation as stated in claim 11.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Wiltshire ('401) and Figura ('109) with Lammert ('446) and Hu ('802) because one could achieve a semiconductor device with a feature size that goes beyond the current capabilities of conventional photolithography processes in order to increase the functional area of the semiconductor device. This is accomplished by, achieving and then maintaining a desired profile of the photoresist within the semiconductor substrate by thermal reflow and then deep UV exposure, and then depositing the conducting layer within the opening after the photoresist is removed.

10. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) in view of Figura ('109) and Lammert ('446) and Hu ('802) as applied to claims 11-14 above, and further in view of Koizumi ('708).

Wiltshire ('401) Figura ('109) Lammert ('446) and Hu ('802) are relied upon as discussed in the rejection of Claims 1-5 and 9-10, in paragraphs 5 and 6, and as further discussed in the rejection of Claims 11-14 in paragraph 9, under 35 USC 103(a).

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Koizumi ('708) is relied upon as discussed in the rejection of Claim 6 under 35 USC 103(a), for its teachings of ozone ashing as set forth above in paragraph 7.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Wiltshire ('401) and Figura ('109) and Lammert ('446) and Hu ('802) with the ozone ashing method disclosed in Koizumi ('708) in order to remove the photoresist material, because very little damage occurs to the semiconductor substrate during the exposure to the ashing atmosphere.

11. Claims 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiltshire ('401) in view of Figura ('109) and Lammert ('446) and Hu ('802) as applied to claims 11-14 above, and further in view of Lin ('786).

Wiltshire ('401) Figura ('109) Lammert ('446) and Hu ('802) are relied upon as discussed in the rejection of Claims 1-5 and 9-10 in paragraph 5 and 6, and as further discussed in the rejection of Claims 11-14 in paragraph 9, under 35 USC 103(a).

Lin ('786) is relied upon as discussed in the rejection of claims 7-8 under 35 USC 103(a) as set forth above in paragraph 8 for its teachings of forming an oxide layer by liquid phase deposition.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Wiltshire ('401) and Figura ('109) and Lammert ('446) and Hu ('786) with teachings of Lin ('786) in order to form a dielectric layer on the sidewall and surface of a storage node of a semiconductor substrate by growing an oxide layer which is a dielectric on the sidewall and surface of the storage node by liquid phase deposition, because the oxide layer formed by liquid phase deposition is selective for photoresist; therefore, it will not grow on the masking layer but instead only the sidewall of the trench in the substrate.

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***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday thru Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

COS  
10-12-06

  
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